

Removal of Dry Type Liner from the Engine Block by Using Hydraulic Operation

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Abstract- There are many possibilities of the overheating which cause the cylinder liner may damage. In old method liner are removed by pneumatic method and cut the liner. Sometimes it may cause damage to the engine block. So that as a perfect solution in hydraulic operation can be used for the replacement of the cylinder liner in engine block. The hydraulic operation will lift the liner upwards easily without causing any damage the engine block. It will reduce the time of removing rate of liner. No high energy is required by human. So that as a solution for the replacement of cylinder liner the oil can be used a medium for hydraulic operation. It could be most useful and handfull.

Keyword: Liner, Hydraulic jack, Cylinder and Engine bloc

1. INTRODUCTION

As presently used in trucks, buses and the like, diesel engines are so installed, as beneath the cab, that there is, on the top of the engine, only enough clearance to allow removal of the cylinder liners or sleeves. There is no extra clearance for a sleeve puller or extractor, and this is true irrespective of whether the cylinders are vertical, at 45° or at 60°. Accordingly, in order to extract or pull the cylinder liners from the engine block, it is necessary to dismount the entire engine from the vehicle and then to position a cylinder extracting arrangement on the top of the engine to pull a cylinder liner upwardly out of a cylinder.

A liner replacement operation thus involves a large amount number of man hours of work, to dismount the engines from the vehicle, to extract the cylinder liners, to replace new or reconditioned cylinder liners, in the engine, to reassemble the engine, and to remount the engine in the vehicle. In effect, replacing a cylinder liner becomes a major and time consuming operation.

This invention relates to the removal and replacement of cylinder liners of diesel engines driving automotive vehicles and more particularly, to an improved, simplified and more efficient method and apparatus for removing and replacing the cylinder liners.

In accordance with invention, cylinder liners are removed from automotive vehicles diesel engine while the engine remains in the vehicles. This is effected by pushing the cylinder liners upwardly out of the cylinders, operating the hydraulic jack on above the engine by remove the cylinder liner upwardly out of the cylinders

Basically the cylinder liner is a hollow cylindrical shell which acts as the enclosure in which the combustion takes place. Of course the word hollow does not imply that it is weak in strength for it is under the fluid pressure due to combustion and hence must withstand the high level of hoop stress induced in it.

Another factor is the big temperature difference on the outside and inside (being in proximity of the combustion chamber) of the liner which tends to induce thermal stresses and the liner has to withstand those as well.

Apart from the liner surface is also resistant to wear and corrosion. The picture below shows the image of a typical cylinder liner which is resting on wooden blocks. As you can seen from the picture it is made up of quite thick material and the empty slots which we see towards the middle are known as scavenge ports.

1.1Cylinder Liner Types

In wet liners the water is in direct contact with outer surface of the liner whereas in dry liners the water is in indirect contact with outer surface of the liner, i.e. cylinder casting contains wet jackets. A leak-off hole is often provided between the upper and lower rings to ensure that water passing the one or oil passing the other runs to the outside of the engine.

The upper part of the liner bore, where the top piston ring reaches the top of its travel, suffers the greatest wear. This is because at this point the ring comes to rest and reverses its direction of motion and it is difficult to maintain an adequate film of oil between the surface of the ring and liner. Also, the gas pressure is highest when the ring is in this position, forcing it hard against the liner.

Besides, the top of the liner is hot from the repeated combustion cycle which tends to dry any oil there is. Liners are sometimes specially designed to promote cooling without sacrificing strength.

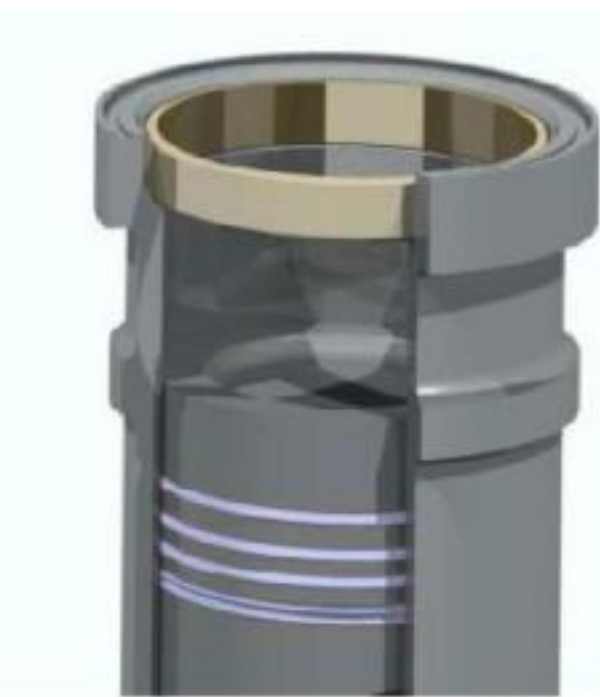


Fig: 1.1 cylinders with piston, and cylinder liner

1.2-CLASSIFICATION OF JACK:-

1.2.1-Mechanical jack:-

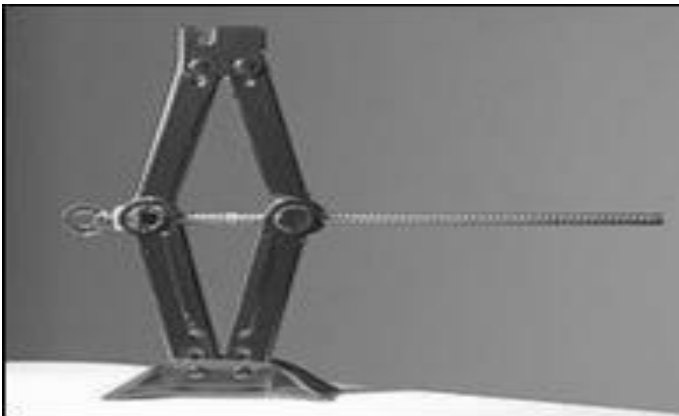


Fig 1.2.1 Mechanical jack

A mechanical jack is a device which lifts heavy equipment. The most common form is a car jack, floor jack or garage jack which lifts vehicles so that maintenance can be performed. Car jacks usually use Mechanical advantage to allow a human to lift a vehicle by manual force alone. More powerful jacks use hydraulic power to provide more lift over greater distances. Mechanical jacks are usually rated for a maximum lifting capacity (for example, 1.5 tons or 3 tons). The jack shown at the right is made for a modern vehicle and the notch fits into a hard point on a unibody. Earlier versions have a platform to lift on the vehicles' frame or axle.

1.2.2-Hydraulic jack:-

Hydraulic jacks are typically used for shop work, rather than as an emergency jack to be carried with the vehicle. Use of jacks not designed for a specific vehicle requires

more than the usual care in selecting ground conditions, the jacking point on the vehicle, and to ensure stability when the jack is extended. Hydraulic jacks are often used to lift elevators in low and medium rise buildings.

A hydraulic jack uses a fluid, which is incompressible, that is forced into a cylinder by a pump plunger. Oil is used since it is self-lubricating and stable. When the plunger pulls back, it draws oil out of the reservoir through a suction check valve into the pump chamber. When the plunger moves forward, it pushes the oil through a discharge check valve into the

cylinder. The suction valve ball is within the chamber and opens with each draw of the plunger. The discharge valve ball is outside the chamber and opens when the oil is pushed into the cylinder. At this point the suction ball within the chamber is forced shut and oil pressure builds in the cylinder.

In a bottle jack the piston is vertical and directly supports a bearing pad that contacts the object being lifted. With a single action piston the lift is somewhat less than twice the collapsed height of the jack, making it suitable only for vehicles with a relatively high clearance. For lifting structures such as houses the hydraulic interconnection of multiple vertical jacks through valves enables the even distribution of forces while enabling close control of the lift.

In a floor jack (aka 'trolley jack') a horizontal piston pushes on the short end of a bellcrank with the long arm providing the vertical motion to a lifting pad, kept horizontal with a horizontal linkage. Floor jacks usually include castors and wheels, allowing compensation for the arc taken by the lifting pad. This mechanism provides a low profile when collapsed, for easy maneuvering underneath the vehicle, while allowing considerable extension.

1.2.3- Pneumatic jack:-

A pneumatic jack is a hydraulic jack that is actuated by compressed air - for example, air from a compressor instead of human work. This eliminates the need for the user to actuate the hydraulic mechanism, saving effort and potentially increasing speed. Sometimes, such jacks are also able to be operated by the normal hydraulic actuation method, thereby retaining functionality, even if a source of compressed air is not available.

A house jack, also called a screw jack is a mechanical device primarily used to lift houses from their foundation. A series of jacks are used and then wood cribbing temporarily supports the structure. This process is repeated until the desired height is reached. The house jack can be used for jacking carrying beams that have settled or for installing new structural beams. On the top of the jack is a cast iron circular pad that the 4" x 4" post is resting on. This pad moves independently of the house jack so that it does not turn as the acme-threaded rod is turned up with a

metal rod. This piece tilts very slightly but not enough to render the post dangerously out of plumb

1.2.4- Strand jack:-

A strand jack is a specialized hydraulic jack that grips steel cables often used in concert, strand jacks can lift hundreds of tons and are used in engineering and construction.

1.3-PASCAL'S LAW:-

Pressure on a confined fluid is transmitted undiminished and acts with equal force on equal areas and at 90 degrees to the container wall. A fluid, such as oil, is displaced when either piston is pushed inward.

The small piston, for a given distance of movement, displaces a smaller amount of volume than the large piston, which is proportional to the ratio of areas of the heads of the pistons. Therefore, the small piston must be moved a large distance to get the large piston to move significantly. The distance the large piston will move is the distance that the small piston is moved divided by the ratio of the areas of the heads of the pistons.

This is how energy, in the form of work in this case, is conserved and the Law of Conservation of Energy is satisfied. Work is force times distance, and since the force is increased on the larger piston, the distance the force is applied over must be decreased.

2.LITERATURE REVIEW

“PNEUMATIC MULTI CYLINDER LINER PULLER” Jagadesh.A.S,Karthi.K,Ravichandran.R,Srinivasan.V (MAY-2016)

There are many possibilities of the cylinder over heating which might cause the cylinder liner damage. So that as a perfect solution the pneumatic cylinder can be used for the replacement of the cylinder liners in engine block.

The pneumatic cylinder liner puller is composed of the simple arrangement of double acting cylinder, solenoid valve, puller plate and pneumatic junction box. So that as a solution for the replacement of cylinder liner the compressed air can be used a medium for pneumatic cylinder movement. It could be most useful and handfull.

2.1 COMPRESSOR

Compressor is used to compress and deliver it in high pressure. Air compressors are utilized to raise the pressure of a volume of air. Air compressors are available in many configurations and will operate over a very wide range of flow rates and pressures. Compressed air was expelled by primitive man to give glowing embers sufficient oxygen to allow them to flare up into a fire.

The air exiting the compressor is saturated with moisture and will have compressor lubricants. Compressor achieves this high pressure delivery by the rotating motion of a piston and a cylinder arrangement.

So thus as in which it helps to send the air into the system with an high pressure. And the compressed air with high pressure can be sent into the system. Air compressors are available in many configurations and will operate over a very wide range of flow rates and pressures.

Compressed air was expelled by primitive man to give glowing embers sufficient oxygen to allow them to flare up into a fire. During the compression process, the temperature increases as the pressure increases. So the outside air can be able to compressed and send to the system in the case of required process to be carried out in the stages of the system. And the high pressure air can be easily obtained from the air compressor. Develop power in one direction only.

2.2 Double acting Cylinders

A double acting cylinder is employed in control systems with the full pneumatic cushioning and it is essential when the cylinder itself is required to retard heavy masses. This can only be done at the end positions of the piston stroke.

In all intermediate position a separate externally mounted cushioning derive most be provided with the damping feature. The normal escape of air is out off by a cushioning piston before the end of the stroke is required.

As a result the sit in the cushioning chamber is again compressed since it cannot escape but slowly according to the setting made on reverses. The air freely enters the cylinder and the piston strokes in the other direction at full.

A solenoid valve is an electro mechanical valve for use with liquid or gas controlled by running or stopping an electrical current through a solenoid, which is a coil of wire, thus changing the state of the valve. The operation of a solenoid valve is similar to that of a light switch, but typically controls the flow of air or water, whereas a light switch typically controls the flow of electricity.

Solenoid valves may have two or more ports: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids release, dose, distribute or mix fluids. Release, dose, distribute or mix fluids.

METHOD AND APPARATUS FOR REMOVING

CYLINDER LINERS OF AUTOMOTIVE VEHICLE DIESEL ENGINES James G.Hodge,523 Bedford Rd.,North tarrytown,N.Y.10591.

Cylinder liners are removed or extracted from the diesel engines of automotive vehicles with the diesel engine remaining mounted on the vehicle, by removing only the pistons, piston rod and bolts holding the main bearing caps and rotating the crank shaft so that the cranks extend

horizontally. The main bearing cap bolts are utilized to sure to the under surface of the main bearing caps in depending relation thereform,a pair of sustainably identical angle brackets having aligned apertures at their lower ends. A cross bar is inserted through these apparatus and a pressing tool is placed in the lower end of the cylinder liner and secured by a threaded bolt and nut to a centring device seated I the upper end of the liner.an ordinary shop jack is then positioned on the cross bar in engagement with the pressing tool, and is extended to push the cylinder liner upwardly out of the cylinder.

3. PROBLEM IDENTIFICATION

A cylinder liner is a cylindrical part to be fitted in to an engine block to form a cylindrical space in which the piston reciprocates very smoothly. The main function of cylindrical liners is to receive the combustion heat through the piston and the piston rings and used to transmit the heat to coolant.

The pistons should come next in the inspection process. Each piston should be examined for cracks, holes, scuffing or excessive pitting. Cracks in the piston will usually be located near the piston pin and/or skirt.

If scuffing is found on the sides of the piston, examine the cylinder liner that the scuffed piston was removed from the engine block. If scuffing is found on the cylinder wall, all cylinders will most likely need to be bored oversize. All pistons would then be replaced.

For this scuffed pistons, to remove the cylinder liners from the engine block. In olden days liners are removed by cut the liner or hit the liner at the head it may cause sometimes damage to the engine block. To overcome these defects by using hydraulic operation to remove the liners from the engine block safely.



Fig 3.1 Piston scuffed

4. MATERIAL USED AND ITS DESCRIPTION

The major parts used in Removal of dry type liner from the engine by using hydraulic operation are described below:

- Bottom liner holder
- Top liner holder
- Length shaft
- Carter pin
- Liner guide way
- Jack mounter
- Hydraulic jack
- Hand Lever

BOTTOM LINER HOLDER

Bottom liner holder is used to carry the liner at the bottom. When the shaft is connected to the bottom holder for to lift the liner upwards.



Fig:4.1 Bottom liner holder

4.2 TOP LINER HOLDER

Top liner holder is mounted at the top of the engine block and liner. It is used to support the liner from the top during the time of removing the liner.



Fig 4.2 Top liner holder

4.3 LENGTH SHAFT

Shaft is the main function to lift the liner safely from the bottom to upward. This shaft is passes through the hydraulic jack and the holders.



Fig 4.3 Length shaft

4.4 CARTER PIN

Carter pin is fixed in between the shaft and top holder. It used to arrest the shaking during the removal of liner from the engine block.



Fig 4.4 Carter pin

4.5 LINER GUIDE WAY

Its main function or purpose is during the liner removed from the block. That liner will come from the space provided inside the guide way.



Fig 4.5 Liner guide way

4.6 JACK MOUNTER

It is used to place the hydraulic jack at the top of these mounter. It is also used to separate the guide way and the hydraulic mounter.



Fig 4.6 Hydraulic Jack Mounter

4.7 HYDRAULIC JACK

A jack is a device that uses force to lift heavy loads. The primary mechanism with which force is applied varies, depending on the specific type of jack, but is typically a screw a hydraulic cylinder.



Fig 4.7 Hydraulic jack

4.8 LEVER

It is used to store the hydraulic oil in these lever tank. It is also used to supply the oil to the jack at the time of pressing the lever.



Fig 4.8 Lever

5.DESIGN CALCULATION

$$F1 = (\pi (d2^2 - d1^2) / 4) P1 \quad (1)$$

Where

F1 = rod force (lb, N)

d1 = rod diameter (in, m)

d2 = piston diameter (in, m)

P1 = pressure in the cylinder on the rod side (lb/in² (psi), N/m² (Pa))

The force produced on opposite side of the rod (2) can be expressed as

$$F2 = (\pi d2^2 / 4) P2 \quad (2)$$

Where

F2 = rod force (lb, N)

P2 = pressure in the cylinder (opposite rod)

(lb/in² (psi), N/m² (Pa))

TO FIND INNER DIAMETER OF CYLINDER

TUBE:-

$$P = \frac{\pi D^2}{4} \times p \quad \text{where, } P = \text{total pressure}$$

D = Inner diameter

p = working pressure

$$3 * 1000 = 0.785 \times D^2 \times 300$$

$$D = 3000 / 0.785 * 300$$

$$D^2 = 12.76$$

D = 6CM = 60MM. (inner diameter of cylinder tube)

TO FIND OUTER DIAMETER OF CYLINDER TUBE:-

$$\text{We have already a equation } = \sigma = p \frac{d_o^2 + d_i^2}{d_o^2 - d_i^2}$$

Where, σ = working stress

P = working pressure

d_o outer diameter of cylinder tube

d_i inner diameter of cylinder tube

$$\text{Working stress} = 4200/4 = 1050$$

KG/CM²

$$\sigma = P \frac{d_o^2 + d_i^2}{d_o^2 - d_i^2}$$

$$1050 = 300 \times \frac{d_o^2 + 12^2}{d_o^2 - 12^2}$$

$$1050d_o - 3780000 = 300d_o + 1080000 \quad 750d_o = 2700000$$

$$d_o = 2700000 / 750 \quad d_o = 20250000 \quad d_o = 73mm$$

THICKNESS OF THE CYLINDER TUBE:-

$$\text{Tube thickness} = \frac{d_o - d_i}{2}$$

$$= 73 - 60 / 2 = 6.5mm$$

DESIGN OF PISTON

We know that cylinder's inner diameter is equal to piston's outer diameter so piston outer diameter is 60mm

. Generally piston's are made from MILD STEEL & SUITABLE MATERIAL.....

DESIGN OF PISTON ROD

Material strength EN9 = 1750 kg/cm²

$$P = \frac{\pi D_o^2}{4} \times \text{STRENGTH}$$

$$3000 = 0.785 * 60 * 60 * 1750$$

$$3000 = 4945500kg/m$$

6. EXPERIMENTAL SETUP

Our project consists of bottom liner holder, top liner holder, carter pin, liner guide way, hydraulic jack lever, hydraulic jack mounter. In this bottom liner holder is placed at the bottom of the cylinder liner which used to support the liner at the bottom during the time of liner moves (or) lift upward while the another holder placed at the top of the cylinder liner.

Shaft plays a major role for lifting the liner from the lower side to upper side these shaft is connected to the centre of the hydraulic jack these shaft extended at the bottom to top. These shaft passes through the top holder and it attached to the bottom holder.

When the man handling force is applied on the hydraulic lever, the hydraulic jack lift the shaft upwards. Carter pin is fitted at the top of the cylinder liner. It is used to arrest the vibration during the time of liner lift upwards. Hydraulic jack is mounted at the mounter.

When the lever is attached to the hydraulic jack for passing the oil from the lever to the jack during the man handling force is applied on the hydraulic jack.

7. WORKING PRINCIPLE

In this project removing the cylinder liner from the engine block by using hydraulic operation. This project consists of top and bottom holder, shaft, carter pin, hydraulic jack, jack mounter, liner guide way, hydraulic lever.

In this project hydraulic jack plays an important role for removing the dry liner from the engine block. When working with hydraulic jack, we must need to insert the metal pumping bar into the handle socket and pump it, which will push the ram up and raises the boom with a load attached to the end. To lower a load need to open the bleed valve located on the base of the jack.

Basically the same Pascal's principle is being used to lift a load. When you activate the pumping system inserting the pumping bar into the handle socket and pumping it, the hydraulic fluid is pushed to the cylinder through a one way valve, applying pressure to the fluid while filling the cylinder.

The fluid can only flow back from the cylinder through another valve which is blocked by a steel ball, to open it you must unscrew the bleed valve located at the bottom of the ram. Because the one way valve does not allow the fluid to go back, the pressure in the cylinder builds, while the jack is being pumped.

The pressure inside the cylinder puts out force and lifts the piston and the ram upwards, allowing to lift heavy loads by continuously applying small force in the

small cylinder, which is multiplied in the larger cylinder. Basically the larger the cylinder is the more weight could lift, which allows to lift very heavy loads simply using a hand pump mechanism.

The shaft from the hydraulic jack is fixed at the bottom of the liner with the help of bottom holder and it also passed through the top holder. During the hand pump is operated the jack lift the shaft upwards and its lift the liner upwards from the engine block easily without any risk to the engine block. In these carter pin is fixed in between the shaft and top holder. It used to arrest the shaking during the removal of liner from the engine block.

8. MODELLING

8.1 MODELLING SOFTWARES

There are most software packages are available for creating the 3D model of the Removal of dry type liner from the engine block by using hydraulic operation and some of the software's are

SOLID WORKS

CREO

CATIA

UNIGRAPHICS

INVENTOR

Here we have chosen the solid works 2014 as the modelling software because of following advantages. It is the feature based modelling software

Associatively

Parametric based design

Design indent

INTRODUCTION ABOUT SOLID WORKS

In part modelling you can create a part from a conceptual sketch through solid feature based modelling, as well as build and modify parts through direct and intuitive graphical manipulations.

The part modelling help introduces you to the terminology, basic design concepts and procedures shows you how to draft a 2D conceptual layout create precise geometry using basic geometric entities and dimensions and constrain your geometry.

You can learn how to build a 3D parametric part from a 2D sketch by combining basic and advanced features such as extrusions, sweeps, cuts, holes,

Slots and rounds

Final part modelling help provides procedures for modifying part features and resolving failures

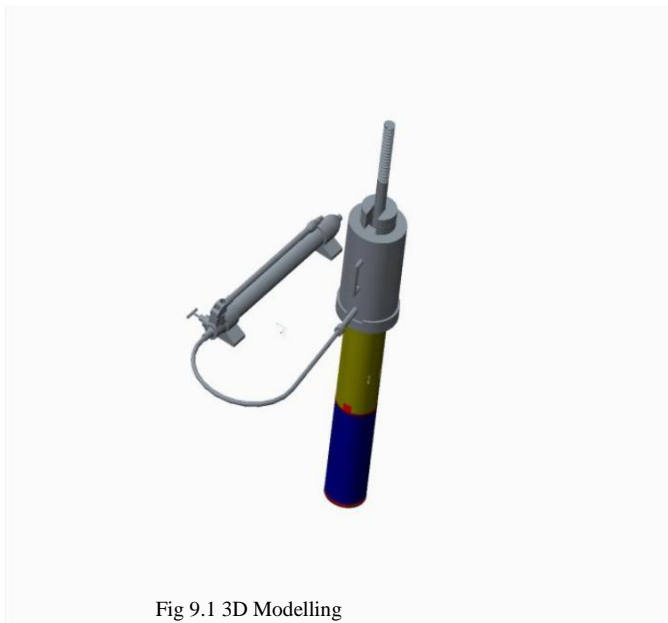


Fig 9.1 3D Modelling

9. APPLICATION AND ADVANTAGE

APPLICATION

Automobile workshop

Engine replacement shop

ADVANTAGE

Low cost of production.

Not much skilled labour is required.

Easy to operate.

Required less space.

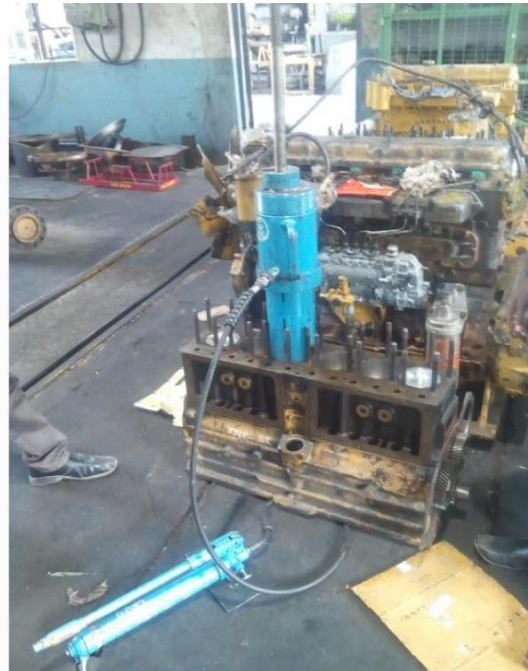
10. CONCLUSION

We make this project entirely different from other projects. We used innovative idea in this concept. From this project we can easily remove the liner from the engine block without any damage the engine body and need not to go for a high cost machine. It concluded that the easy way to remove liner and easily portable.

11. FEATURE DEVELOPMENT

In this project we can use the manual operation method only. In feature may possible to fit the electrical motor instead of using manual pedalling. In this we can reduce the time consumption when compare to the manually operation

12. PHOTOGRAPHY



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